the south-east portion of Australia, and passes in a north-eastern direction, crossing the equator in about longitude 154° W. It then sweeps round in an easterly direction, terminating in about longitude 90° W. just off the west coast of Central America. The line thus extends over the full width of the Pacific Ocean, and it is therefore from islands in that ocean that the expeditions which may be sent out will have to make their observations. While there is a great number of islands in this ocean, there are, unfortunately, remarkably few which lie in the narrow band of the totality track. Following the line from west to east, the first that one finds on the Admiralty chart is Tofua, in the Tonga or Friendly Islands. The next that is met with is Vavau, in the same group, and also close to the central line of totality. Much further eastward we reach Nassau, which lies a little to the south of the central line, but well within the central zone, and not far away are the Danger Islands, which are situated to the north, but further away from the central line. Thus, so far as is indicated on the chart, there are only four available points from which observations can be made.

In order to find out the suitability of these islands for eclipse parties, Mr. F. K. McClean determined to make detailed inquiries on this point on his way out to the recent eclipse, travelling from England *viâ* San Francisco and New Zealand specially to gather this information. Particulars are now to hand, and at his request they are published here so that intending observers may benefit thereby.

With regard to Tofua the information is brief and concise. It is that Tofua is an active volcano and high, and therefore unsuitable. As regards Vavau he says very little, because, as he knows, it is generally recognised as being a good place for observation. He adds, however, that there are hills there several hundred feet in height; that the island is called at by mail steamers; and, finally, that there are many small and low islands in the neighbourhood.

Coming now to Nassau and Danger Islands, these are described as "difficult, but possible by using owner's boat and landing tackle." As observing stations he defines them as "good." The mode of procedure to utilise these islands is suggested by him in the following words:—

> A small steamer of several hundred tons (*The Dawn*), belonging to Captain E. F. Allen, runs to both Nassau and Danger. He does the whole of the landing and embarking of copra, &c. This steamer would have to be chartered at approximately 40*l.* per day when under steam and 20*l.* when not under steam. . . . Captain Allen says that he would undertake to get all cases on shore in good condition if they were water-tight, but he cannot undertake to keep them dry. If for any reason he could not land on one island, he could on the other in any reasonable weather conditions.

In most of the Pacific islands the chief difficulties to be met with are confined to the landing and embarking of the *personnel* and material. As many of the islands are fringed with coral reefs, with only small, narrow passages through them, in some cases natural, in others made by blasting operations, considerable skill is required in negotiating the breakers, and special surf boats are usually required. Mr. McClean's advice, therefore, is that it is almost imperative to employ someone accustomed to such work, "as certainly no one unused to the conditions could do it."

Should any of the parties who intend to go out on the occasion of this eclipse wish to locate themselves on some island other than Vavau, then Nassau and Danger Islands are their only alternatives. It is hoped, however, that one or other of these will be made use of, as they are sufficiently distant from Vavau to be subject to different weather conditions should the parties at Vavau be clouded out.

WILLIAM J. S. LOCKYER.

GLACIERS, GOLDFIELDS, AND LANDSLIDES IN NORTH AMERICA.[1]

AS an example of organised public research, the U.S. Geological Survey is unparalleled in its activity. Bulletins, professional papers, monographs and reports flow from the Government Printing Office at Washington in a stream that is well-nigh overwhelming to the student who tries to arrest it for systematic examination. Written, or brought by capable editing, to a standard of lucidity that is positively monotonous, well printed, lavishly illustrated, and distributed with enlightened generosity, these publications contain a store of precise information which illuminates every branch of earth-knowledge. The range of subjects which they cover is no longer confined even within the spacious limits of geology, palæontology, petrology, mineralogy and physiography;—it has overspread into many cognate branches of applied science, such as analytical chemistry, hydraulics, mechanics, engineering, metallurgy and mineral statistics.

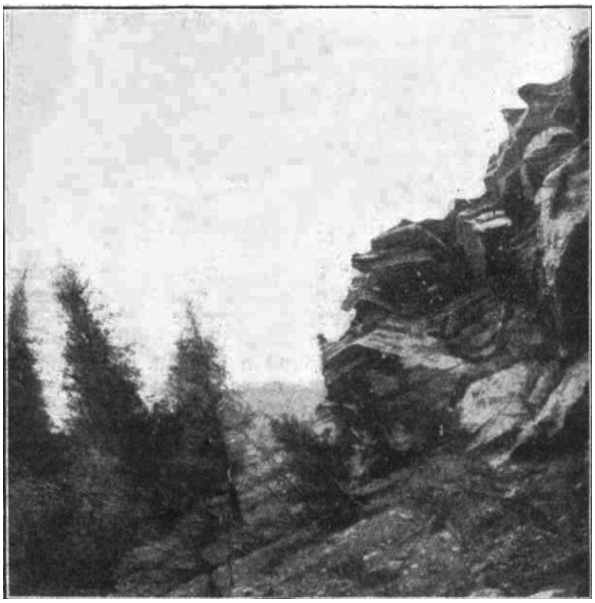

FIG. 1.—Margin of Atrevida Glacier west of Esker Stream. Trees being buried by the ice.

The three handsome memoirs before us are good examples of the broad spirit in which the work is carried out; each, while dealing primarily with a particular district, is a notable addition to our knowledge of the continent as a whole; and each finds room for matter likely to be interesting to any educated reader, along with that which appeals directly to the specialist. In the first and third, the physiographical study of the subject is made paramount; in the second, petrology, mineralogy and mining receive the fullest treatment.

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[1] Professional Papers of U.S. Geological Survey. (Washington, 1909.)

(1) No. 64, "The Yakutat Bay Region, Alaska: Physiography and Glacial Geology." By Ralph S. Tarr; "Areal Geology." By R. S. Tarr and Bert S. Butler. Pp. 183; with 37 plates and 10 figures.

(2) No. 66, "The Geology and Ore Deposits of Goldfield, Nevada." By F. L. Ransome, assisted in the field by W. H. Emmons and G. H. Garrey. Pp. 258; with 2 maps, 33 plates and 34 figures.

(3) No. 67, "Landslides in the San Juan Mountains, Colorado, including a Consideration of their Causes and their Classification." By E. Howe. Pp. 58; with 20 plates and 4 figures.

(1) Of especial interest is the professional paper first on our list, containing the results of Prof. Tarr's recent investigation of the great glaciers in the Yakutat Bay region of Alaska. We may congratulate ourselves, and Prof. Tarr also, on the happy mischance which took him to this region at a critical time in the history of its ice-fields.

Ever since the famous explorations of the late Prof. I. C. Russell, twenty years ago, we have known that where the greatest of these ice-rivers left the mountain valleys and deployed as "piedmont" glaciers on the low ground bordering the ocean, they were characterised by their peculiarly stagnant condition. The anomaly of dense living forests covering their surfaces over large areas where the ice was hidden beneath a thick blanket of moraine was one of the many surprises brought to our knowledge by Russell; and later investigations confirmed the idea that in such cases the ice was truly "dead" and would remain where it was, a waning relic of severer bygone times, until gradually dispersed by liquefaction.

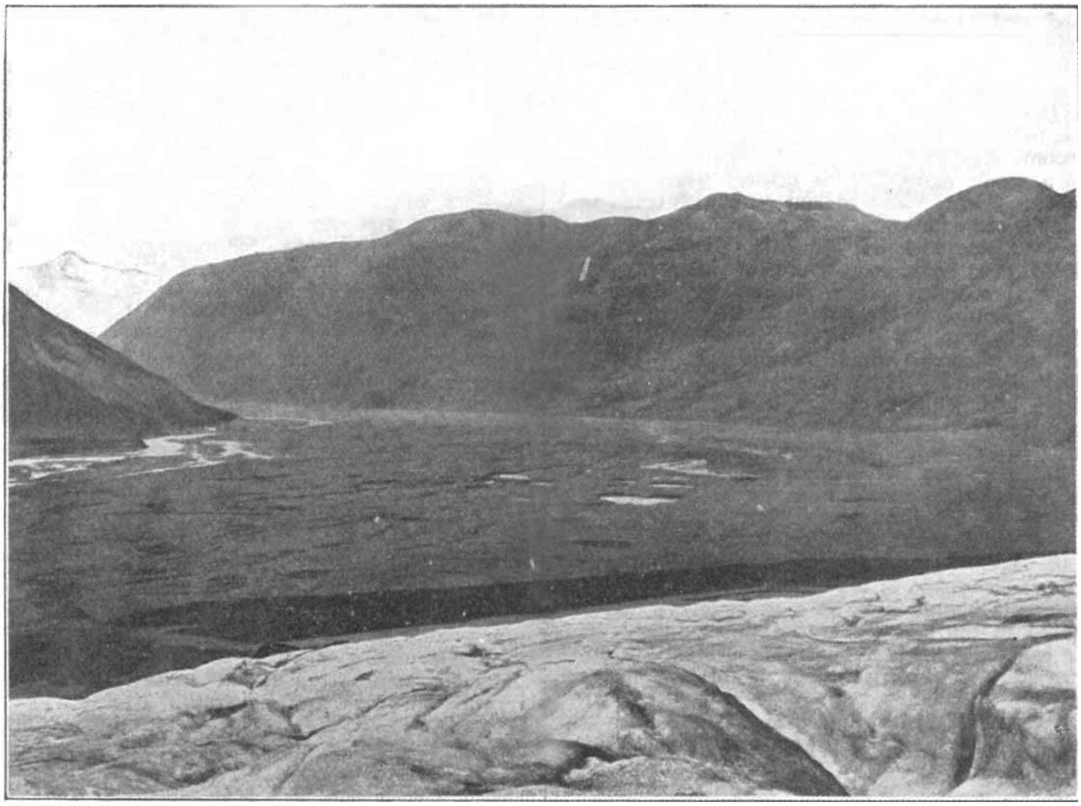

FIG. 2.—View looking west from Hidden Glacier showing the Fosse and the Pitted Plain.

Such was still the state of affairs when Prof. Tarr began his survey-work in the region in the summer of 1905, and he confidently planned a programme for the following year which depended for its fulfilment on the "deadness" of the ice. On his return in 1906 he was naturally astonished to find that all was in a turmoil of change—familiar features obliterated—routes impossible. The "dead ice" in many places had sprung to life again—the plains that had formed the highways of former travel were broken into an impenetrable wilderness of crevasses—the blanket of moraine was sliding out of sight into the yawning chasms—the green forests that covered it were sharing the same fate—the snouts of the glaciers were being thrust forward destructively into the timbered belt surrounding them—the enormously augmented streams issuing from the ice were impassable, and were flinging out huge delta-fans that buried everything in their path; and, altogether, nature in one of her most vigorous moods was enacting a grand transformation scene on the lonely shores of Yakutat Bay. All the eastern portion of the great Malaspina Glacier was a maze of crevasses, and its end—formerly an easy slope—an insurmountable cliff of tumbling ice, trees, and moraine. The Atrevida (see Fig. 1), the Variegated, the Marvine and the Haenke Glaciers were in the same state of rapid disruption; while others, including the Lucia and the Seward, though not so fully aroused, showed symptoms of impending change.[1]

Yet there were other glaciers in the region that had not participated in this energetic outburst, but still kept to the habit of recession which had been regarded as the normal behaviour of all these Alaskan glaciers.

Here, then, was the unexpected problem that confronted Prof. Tarr in 1906 and richly recompensed him for the destruction of his original plans. His solution of it is remarkably simple, and seems to fulfil all the conditions. It is well known that in 1899 the region was affected by a sharp earthquake, which caused displacements recognisable on the coast-line and shook up the famous Muir Glacier so thoroughly that its seaward end was disintegrated, filling Glacier Bay with icebergs that barred out all shipping for some years. Prof. Tarr gathered evidence proving that the earthquake brought down huge avalanches of snow and rock from the mountain-sides into the glacier-basins, and he considers that the sudden accession of material has exerted a thrust which has swept slowly forward as a wave throughout the length of the glaciers. He strengthens his conclusion by showing that, at least in some cases, the unaffected glaciers are those fed from gentler slopes from which avalanches would be less likely.

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[1] In the *National Geographic Magazine* for January last Prof. Tarr and Prof. L. Martin give an account of their later visit to the region in the summer of 1909, when further changes were noted. The Lucia Glacier had become unpassable; the Hidden Glacier had undergone the full cycle of change; the Hubbard seemed to be on the eve of great movement; while the four mentioned above as active in 1906 had relapsed into stagnation.

The explanation raises many knotty points in the still imperfectly understood physics of glacier-movement, while the new facts constitute a very important element to be taken into account in all future discussions of ice-flow. In reading the descriptions we are reminded of the abnormal conditions found by Garwood and Gregory in the Booming Glacier of Spitsbergen (Quart. Journ. Geol. Soc., vol. liv., 1898, p. 207), and of the rapid advance and subsequent recession of the Hispar Glacier in the Karakoram Range (*Geographical Journal,* vol. xxxv., February, 1910, p. 108). Is it possible that a great mass of ice may become suddenly more mobile when its temperature as a whole reaches some critical point short of the melting stage? The glacial geologist could find ready application for some such proposition if it were presented to him with the requisite Q.E.D.

Besides these features of central interest, Prof. Tarr describes many other phenomena that will arrest the attention of the geologist; for example, the rock-channels cut by streams running along the margins of glaciers, which remind us of the old "overflow channels" lately recognised in many parts of Britain and Ireland; the "pitted plains," where morainic deposits have been spread out by streams in great "apron-fans" incorporating hidden masses of ice (see Fig. 2); the sudden slipping of a small mountain-glacier *en masse* from its high corrie into the waters of Disenchantment Bay, causing huge waves that swept destructively on to the land; and the spread of vegetation over the areas abandoned by the ice. His re-discussion of the efficacy of the glaciers as erosive agents should also be read by everyone who has shared in the long debate on this subject. The memoir concludes with a short account of the solid geology of the region, which is of less general moment.

We have scant space in which to deal with the other two memoirs, and must perforce dismiss them summarily.

(2) Mr. F. L. Ransome's monograph describes an area around Goldfield, on the hilly desert-plateau country near the border of south-western Nevada, which has recently sprung into prominence as a gold-mining centre. His historical narrative has a touch of romance in it—vast treasure lying close to the surface, yet passed over again and again by eager prospectors; then, in 1902, discovery—excitement—and disappointment; in 1903–5, renewed search crowned by success; great fortunes rapidly made and lost in the wild boom and its reaction, the feverish activity culminating in a fierce labour dispute which necessitated the calling up of federal troops at the close of 1907; and finally, the consolidation of interests and the systematic ransacking of the ground. It is estimated that the value of the precious metals recovered during the years 1904–7 from this small field was close upon 20,000,000 dollars.

As for its geology, the field is a low dome-like uplift of Tertiary lavas with associated lake-sediments, resting upon a sparingly-exposed foundation of ancient granitic and metamorphic rocks. The ore-bodies, apparently deposited in late-Tertiary times from "acidified" solutions at no great depth, are remarkable alike for their richness and for their irregularity. The structure, origin and mineralogy of the lodes, and the petrology and chemical composition of the rocks are fully discussed, and beautifully illustrated in the plates. In respect to the eruptive sequence, the author finds no proof of the regular order which J. E. Spurr has sought to establish for the lavas of the Great Basin. In criticising this scheme the author remarks:—"To some minds the conformity here shown may appeal as corroborative, but to others, impressed by the scanty representation of the numerous members of the ideal succession in any given locality, the capacity of the scheme for assimilating not only observed sequences, but imaginary ones, raises doubt whether it really represents natural processes" (p. 105). The criticism might be applied to many another ingenious scheme in science.

(3) The San Juan Mountains in south-western Colorado, like most steep mountains of similar structure, have been subject in the past, and are still subject, to extensive landslips. Many examples of these slips, both ancient and modern, are fully described by Mr. E. Howe in the third paper on our list, and are pictured in many fine plates which almost make description superfluous. A massive series of Tertiary volcanic rocks, often carved into huge cliffs, rests on a yielding base of soft Cretaceous shales; and, among the older sedimentary formations, are thick Palæozoic limestones resting on friable shales and sandstones. Attention is particularly directed to the curious "rock-streams" which have their origin in the high cirques; and to the influence of snow-banks on the accumulation of talus at the foot of cliffs. The memoir concludes with a somewhat laboured classification of landslides in which foreign examples and their literature are freely cited.

G. W. L.

MOUNTAINEERING IN THE NORTH-WEST HIMALAYA.[1]

ONE would hardly suppose, after reading this simply-told narrative of physical achievements, that the senior member—and shall we say, with Mrs. Workman's permission, leader—of the party among the peaks and glaciers of the Nun Kun group was compelled some years ago to retire from his medical practice on account of ill-health. Evidently, at great altitudes, where the vitality is lowered by insomnia attending deficient oxygenation, and where mental depression and attacks of irresolution follow a disturbed circulation, the successful explorer depends wholly on having his muscles under the complete control of a resolute mind for that last supreme fight against the irresistible instinct to descend to his natural environment. The Arctic explorer can sleep, can eat, and is the better for work to do; the mountain climber handicaps himself by his load of protective non-conductors; his respiratory difficulties are increased when in the only position of rest left to the biped, and every momentary doze through sheer exhaustion is terminated by frantic efforts to avoid the intolerable feeling of suffocation. Anyone who has experienced these troubles, which beset all climbers—even the lucky few who are proof against mountain sickness—will admire the mental as well as the physical qualities of the altitude record-breaker; for, judging by the recent sordid controversy among Arctic ex-

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[1] "Peaks and Glaciers of Nun Kun: a Record of Pioneer-Exploration and Mountaineering in the Punjab Himalaya." By Fanny Bullock Workman and Dr. W. H. Workman. Pp. xv+204. (London: Constable and Co., Ltd., 1909.) Price 18*s.* net.